

Q241



T-52-09

# 74ACQ241 • 54ACTQ/74ACTQ241

## Quiet Series Octal Buffer/Line Driver with TRI-STATE® Outputs

### General Description

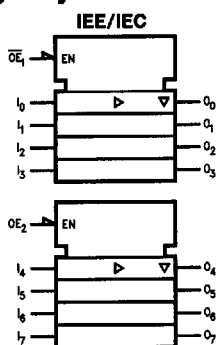
The 'ACQ/'ACTQ241 is an octal buffer and line driver designed to be employed as a memory address driver, clock driver and bus oriented transmitter or receiver which provides improved PC board density. The ACQ/ACTQ utilizes NSC Quiet Series technology to guarantee quiet output switching and improved dynamic threshold performance. FACT Quiet Series™ features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

### Features

- $I_{CC}$  and  $I_{OZ}$  reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed pin-to-pin skew AC performance
- Improved latch-up immunity
- TRI-STATE® outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24 mA
- Faster prop delays than the standard 'AC/'ACT241
- 4 kV minimum ESD immunity ('ACTQ)
- Standard Military Drawing (SMD)  
— 'ACTQ241: 5962-92185

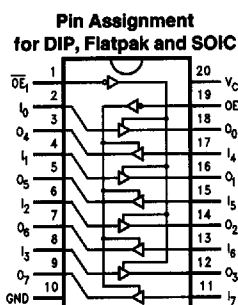
**Ordering Code:** See Section 8

### Logic Symbol

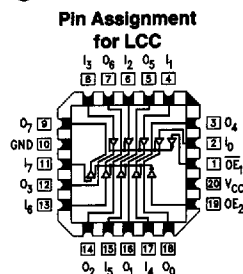


TL/F/10642-1

### Connection Diagrams



TL/F/10642-2



TL/F/10642-3

| Pin Names                          | Description                    |
|------------------------------------|--------------------------------|
| $\overline{OE}_1, \overline{OE}_2$ | TRI-STATE Output Enable Inputs |
| $I_0-I_7$                          | Inputs                         |
| $O_0-O_7$                          | Outputs                        |

| Inputs            |       | Outputs<br>(Pins 12, 14, 16, 18) |
|-------------------|-------|----------------------------------|
| $\overline{OE}_1$ | $I_n$ |                                  |
| L                 | L     | L                                |
| L                 | H     | H                                |
| H                 | X     | Z                                |

| Inputs            |       | Outputs<br>(Pins 3, 5, 7, 9) |
|-------------------|-------|------------------------------|
| $\overline{OE}_2$ | $I_n$ |                              |
| H                 | L     | L                            |
| H                 | H     | H                            |
| H                 | X     | Z                            |

H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Immaterial  
Z = High Impedance

### Absolute Maximum Rating (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|  |                          |
|--|--------------------------|
| Supply Voltage ( $V_{CC}$ )  | -0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )                                    |                          |
| $V_I = -0.5V$  | -20 mA                   |
| $V_I = V_{CC} + 0.5V$  | +20 mA                   |
| DC Input Voltage ( $V_I$ )   | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ )                                   |                          |
| $V_O = -0.5V$  | -20 mA                   |
| $V_O = V_{CC} + 0.5V$  | +20 mA                   |
| DC Output Voltage ( $V_O$ )  | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Source or Sink Current ( $I_O$ )                             | ±50 mA                   |
| DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | ±50 mA                   |
| Storage Temperature ( $T_{STG}$ )                                      | -65°C to +150°C          |
| DC Latch-Up Source or Sink Current                                     | ±300 mA                  |
| Junction Temperature ( $T_J$ )   |                          |
| CDIP   | 175°C                    |
| PDIP   | 140°C                    |

### Recommended Operating Conditions

|   |                 |
|---|-----------------|
| Supply Voltage ( $V_{CC}$ )                 |                 |
| 'ACQ  | 2.0V to 6.0V    |
| 'ACTQ                                       | 4.5V to 5.5V    |
| Input Voltage ( $V_I$ )                     | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                    | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )             |                 |
| 74ACQ/ACTQ                                  | -40°C to +85°C  |
| 54ACTQ                                      | -55°C to +125°C |
| Minimum Input Edge Rate $\Delta V/\Delta t$ |                 |
| 'ACQ Devices                                |                 |
| $V_{IN}$ from 30% to 70% of $V_{CC}$        |                 |
| $V_{CC}$ @ 3.0V, 4.5V, 5.5V                 | 125 mV/ns       |
| Minimum Input Edge Rate $\Delta V/\Delta t$ |                 |
| 'ACTQ Devices                               |                 |
| $V_{IN}$ from 0.8V to 2.0V                  |                 |
| $V_{CC}$ @ 4.5V, 5.5V                       | 125 mV/ns       |

Note: All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from -40°C to +125°C.

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT circuits outside databook specifications.

### DC Electrical Characteristics for 'ACQ Family Devices

| Symbol   | Parameter                         | $V_{CC}$ (V) | 74ACQ               |                   | 74ACTQ                                      |      | Units | Conditions                             |  |
|----------|-----------------------------------|--------------|---------------------|-------------------|---|------|-------|--|--|
|          |                                   |              | $T_A = +25^\circ C$ |                   | $T_A = -40^\circ C \text{ to } +85^\circ C$ |      |       |  |  |
|          |                                   |              | Typ                 | Guaranteed Limits |   |      |       |  |  |
| $V_{IH}$ | Minimum High Level Input Voltage  | 3.0          | 1.5                 | 2.1               | 2.1   |      | V     | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$ |  |
|          |                                   | 4.5          | 2.25                | 3.15              | 3.15  |      |       |  |  |
|          |                                   | 5.5          | 2.75                | 3.85              | 3.85  |      |       |  |  |
| $V_{IL}$ | Maximum Low Level Input Voltage   | 3.0          | 1.5                 | 0.9               | 0.9   |      | V     | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$ |  |
|          |                                   | 4.5          | 2.25                | 1.35              | 1.35  |      |       |  |  |
|          |                                   | 5.5          | 2.75                | 1.65              | 1.65  |      |       |  |  |
| $V_{OH}$ | Minimum High Level Output Voltage | 3.0          | 2.99                | 2.9               | 2.9   |      | V     | $I_{OUT} = -50 \mu A$                  |  |
|          |                                   | 4.5          | 4.49                | 4.4               | 4.4   |      |       |  |  |
|          |                                   | 5.5          | 5.49                | 5.4               | 5.4   |      |       |  |  |
|          |                                   |              | 3.0                 |                   | 2.56  | 2.46 |       | V                                      | * $V_{IN} = V_{IL}$ or $V_{IH}$<br>-12 mA<br>$I_{OH}$ -24 mA<br>-24 mA |
|          |                                   |              | 4.5                 |                   | 3.86  | 3.76 |       |  |  |
|          |                                   |              | 5.5                 |                   | 4.86  | 4.76 |       |  |  |
| $V_{OL}$ | Maximum Low Level Output Voltage  | 3.0          | 0.002               | 0.1               | 0.1   |      | V     | $I_{OUT} = 50 \mu A$                   |  |
|          |                                   | 4.5          | 0.001               | 0.1               | 0.1   |      |       |  |  |
|          |                                   | 5.5          | 0.001               | 0.1               | 0.1   |      |       |  |  |
|          |                                   |              | 3.0                 |                   | 0.36  | 0.44 |       | V                                      | * $V_{IN} = V_{IL}$ or $V_{IH}$<br>12 mA<br>$I_{OL}$ 24 mA<br>24 mA    |
|          |                                   |              | 4.5                 |                   | 0.36  | 0.44 |       |  |  |
|          |                                   |              | 5.5                 |                   | 0.36  | 0.44 |       |  |  |
| $I_{IN}$ | Maximum Input Leakage Current     | 5.5          |                     | ±0.1              | ±1.0  |      | μA    | $V_I = V_{CC}, GND$<br>(Note 1)        |  |

\*All outputs loaded; thresholds on input associated with output under test.

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### DC Electrical Characteristics for 'ACQ Family Devices (Continued)

| Symbol           | Parameter                                    | V <sub>CC</sub> (V) | 74ACQ                  |                   | 74ACQ                           |  | Units | Conditions   |
|------------------|--|---------------------|------------------------|-------------------|---------------------------------|--|-------|--|
|                  |  |                     | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -40°C to +85°C |  |       |  |
|                  |  |                     | Typ                    | Guaranteed Limits |                                 |  |       |  |
| I <sub>OLD</sub> | † Minimum Dynamic Output Current             | 5.5                 |                        |                   | 75                              |  | mA    | V <sub>OLD</sub> = 1.65V Max   |
| I <sub>OHD</sub> |  | 5.5                 |                        |                   | -75                             |  | mA    | V <sub>OHD</sub> = 3.85V Min   |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current             | 5.5                 |                        | 4.0               | 40.0                            |  | μA    | V <sub>IN</sub> = V <sub>CC</sub> or GND (Note 1)  |
| I <sub>OZ</sub>  | Maximum TRI-STATE Leakage Current            | 5.5                 |                        | ±0.25             | ±2.5                            |  | μA    | V <sub>I(OE)</sub> = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>I</sub> = V <sub>CC</sub> , GND<br>V <sub>O</sub> = V <sub>CC</sub> , GND |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                 | 1.1                    | 1.5               |                                 |  | V     | Figures 2-12, 13 (Notes 2, 3)  |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                 | -0.6                   | -1.2              |                                 |  | V     | Figures 2-12, 13 (Notes 2, 3)  |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     | 5.0                 | 3.1                    | 3.5               |                                 |  | V     | (Notes 2, 4)   |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      | 5.0                 | 1.9                    | 1.5               |                                 |  | V     | (Notes 2, 4)   |

† Maximum test duration 2.0 ms, one output loaded at a time.

Note 1: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

Note 2: Plastic DIP package.

Note 3: Max number of outputs defined as (n). Data Inputs are driven 0V to 5V. One output @ GND.

Note 4: Max number of Data Inputs (n) switching, n-1 Inputs switching 0V to 5V ('ACQ). Input-under-test switching: 5V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f = 1 MHz.

### DC Electrical Characteristics for 'ACTQ Family Devices

| Symbol          | Parameter                         | V <sub>CC</sub> (V) | 74ACTQ                 |                   | 54ACTQ                           |      | 74ACTQ                          |    | Units                                  | Conditions  |
|-----------------|-----------------------------------|---------------------|------------------------|-------------------|----------------------------------|------|---------------------------------|----|--|---|
|                 |                                   |                     | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -55°C to +125°C |      | T <sub>A</sub> = -40°C to +85°C |    |  |   |
|                 |                                   |                     | Typ                    | Guaranteed Limits |                                  |      |                                 |    |  |   |
| V <sub>IH</sub> | Minimum High Level Input Voltage  | 4.5                 | 1.5                    | 2.0               | 2.0                              | 2.0  | 2.0                             |    | V                                      | V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V |
|                 |                                   | 5.5                 | 1.5                    | 2.0               | 2.0                              | 2.0  | 2.0                             |    |  |   |
| V <sub>IL</sub> | Maximum Low Level Input Voltage   | 4.5                 | 1.5                    | 0.8               | 0.8                              | 0.8  | 0.8                             |    | V                                      | V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V |
|                 |                                   | 5.5                 | 1.5                    | 0.8               | 0.8                              | 0.8  | 0.8                             |    |  |   |
| V <sub>OH</sub> | Minimum High Level Output Voltage | 4.5                 | 4.49                   | 4.4               | 4.4                              | 4.4  | 4.4                             |    | V                                      | I <sub>OUT</sub> = -50 μA                         |
|                 |                                   | 5.5                 | 5.49                   | 5.4               | 5.4                              | 5.4  | 5.4                             |    |  |   |
|                 |                                   | 4.5                 |                        | 3.86              | 3.70                             | 3.76 |                                 | V  |  |   |
| 5.5             |                                   | 4.86                | 4.70                   | 4.76              |                                  |      |                                 |    |  |   |
| V <sub>OL</sub> | Maximum Low Level Output Voltage  | 4.5                 | 0.001                  | 0.1               | 0.1                              | 0.1  | 0.1                             |    | V                                      | I <sub>OUT</sub> = 50 μA                          |
|                 |                                   | 5.5                 | 0.001                  | 0.1               | 0.1                              | 0.1  | 0.1                             |    |  |   |
|                 |                                   | 4.5                 |                        | 0.36              | 0.50                             | 0.44 |                                 | V  |  |   |
| 5.5             |                                   | 0.36                | 0.50                   | 0.44              |                                  |      |                                 |    |  |   |
| I <sub>IN</sub> | Maximum Input Leakage Current     | 5.5                 |                        | ±0.1              | ±1.0                             | ±1.0 |                                 | μA | V <sub>I</sub> = V <sub>CC</sub> , GND |   |

\*All outputs loaded; thresholds on input associated with output under test.

**DC Electrical Characteristics for 'ACTQ Family Devices** (Continued)

| Symbol           | Parameter                                    | V <sub>CC</sub> (V) | 74ACTQ                 |                   | 54ACTQ                           |  | 74ACTQ                          |  | Units | Conditions   |
|------------------|--|---------------------|------------------------|-------------------|----------------------------------|--|---------------------------------|--|-------|--|
|                  |  |                     | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -55°C to +125°C |  | T <sub>A</sub> = -40°C to +85°C |  |       |  |
|                  |  |                     | Typ                    | Guaranteed Limits |                                  |  |                                 |  |       |  |
| I <sub>OZ</sub>  | Maximum TRI-STATE Leakage Current            | 5.5                 |                        | ±0.25             | ±5.0                             |  | ±2.5                            |  | μA    | V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>O</sub> = V <sub>CC</sub> , GND |
| I <sub>CC1</sub> | Maximum I <sub>CC</sub> /Input               | 5.5                 | 0.6                    |                   | 1.6                              |  | 1.5                             |  | mA    | V <sub>I</sub> = V <sub>CC</sub> - 2.1V  |
| I <sub>OLD</sub> | †Minimum Dynamic Output Current              | 5.5                 |                        |                   | 50                               |  | 75                              |  | mA    | V <sub>OLD</sub> = 1.65V Max   |
| I <sub>OHD</sub> |  | 5.5                 |                        |                   | -50                              |  | -75                             |  | mA    | V <sub>OHD</sub> = 3.85V Min   |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current             | 5.5                 |                        | 4.0               | 80.0                             |  | 40.0                            |  | μA    | V <sub>IN</sub> = V <sub>CC</sub> or GND (Note 1)  |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                 | 1.1                    | 1.5               |                                  |  |                                 |  | V     | Figures 2-12, 13 (Notes 2, 3)  |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                 | -0.6                   | -1.2              |                                  |  |                                 |  | V     | Figures 2-12, 13 (Notes 2, 3)  |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     | 5.0                 | 1.9                    | 2.2               |                                  |  |                                 |  | V     | (Notes 2, 4)   |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      | 5.0                 | 1.2                    | 0.8               |                                  |  |                                 |  | V     | (Notes 2, 4)   |

†Maximum test duration 2.0 ms, one output loaded at a time.

**Note 1:** I<sub>CC</sub> for 54ACTQ @ 25°C is identical to 74ACTQ @ 25°C.

**Note 2:** Plastic DIP package.

**Note 3:** Max number of outputs defined as (n). Data Inputs are driven 0V to 3V. One output @ GND.

**Note 4:** Max number of Data Inputs (n) switching. n - 1 Inputs switching 0V to 3V (ACTQ). Input-under-test switching: 3V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f = 1 MHz.

**AC Electrical Characteristics:** See Section 2 for Waveforms

| Symbol                                | Parameter                              | V <sub>CC</sub> * (V) | 74ACQ  |     |      | 74ACQ   |      | Units | Fig. No. |
|---------------------------------------|--|-----------------------|--|-----|------|---|------|-------|----------|
|                                       |  |                       | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      |       |          |
|                                       |  |                       | Min  | Typ | Max  | Min   | Max  |       |          |
| t <sub>PHL</sub> , t <sub>PLH</sub>   | Propagation Delay Data to Output       | 3.3                   | 2.0  | 6.5 | 9.0  | 2.0   | 9.5  | ns    | 2-3, 4   |
|                                       |  | 5.0                   | 1.5  | 4.5 | 6.0  | 1.5   | 6.5  |       |          |
| t <sub>PZL</sub> , t <sub>PZH</sub>   | Output Enable Time                     | 3.3                   | 2.5  | 8.0 | 13.0 | 2.5   | 13.5 | ns    | 2-5, 6   |
|                                       |  | 5.0                   | 1.5  | 5.5 | 8.5  | 1.5   | 9.0  |       |          |
| t <sub>PHZ</sub> , t <sub>PLZ</sub>   | Output Disable Time                    | 3.3                   | 1.0  | 8.5 | 14.5 | 1.0   | 15.0 | ns    | 2-5, 6   |
|                                       |  | 5.0                   | 1.0  | 5.5 | 9.5  | 1.0   | 10.0 |       |          |
| t <sub>OSSL</sub> , t <sub>OSLH</sub> | Output to Output Skew **Data to Output | 3.3                   |  | 1.0 | 1.5  |   | 1.5  | ns    |          |
|                                       |  | 5.0                   |  | 0.5 | 1.0  |   | 1.0  |       |          |

\*Voltage Range 5.0 is 5.0V ± 0.5V.

Voltage Range 3.3 is 3.3V ± 0.3V.

\*\*Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t<sub>OSSL</sub>) or LOW to HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

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**AC Electrical Characteristics:** See Section 2 for Waveforms

| Symbol                                   | Parameter                                 | V <sub>CC</sub> * (V) | 74ACTQ   |     |      | 54ACTQ  |      | 74ACTQ   |      | Units | Fig. No. |
|--|---|-----------------------|--|-----|------|---|------|--|------|-------|----------|
|  |   |                       | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |      | T <sub>A</sub> = -40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF |      |       |          |
|  |   |                       | Min  | Typ | Max  | Min   | Max  | Min  | Max  |       |          |
| t <sub>PHL</sub> , t <sub>PLH</sub>      | Propagation Delay<br>Data to Output       | 5.0                   | 1.5  | 5.0 | 6.5  | 1.5   | 8.0  | 1.5  | 7.0  | ns    | 2-3, 4   |
| t <sub>PZL</sub> , t <sub>PZH</sub>      | Output Enable Time                        | 5.0                   | 1.5  | 6.5 | 9.0  | 1.5   | 10.5 | 1.5  | 9.5  | ns    | 2-5, 6   |
| t <sub>PHZ</sub> , t <sub>PLZ</sub>      | Output Disable Time                       | 5.0                   | 1.0  | 7.0 | 10.0 | 1.5   | 9.5  | 1.0  | 10.5 | ns    | 2-5, 6   |
| t <sub>OSSL</sub> ,<br>t <sub>OSLH</sub> | Output to Output<br>Skew **Data to Output | 5.0                   |  | 0.5 | 1.0  |   |      |  | 1.0  | ns    |          |

\*Voltage Range 5.0 is 5.0V ±0.5V.

\*\*Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t<sub>OSH</sub>) or LOW to HIGH (t<sub>OSL</sub>). Parameter guaranteed by design.

**Capacitance**

| Symbol          | Parameter                        | Typ | Units | Conditions             |
|-----------------|----------------------------------|-----|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance                | 4.5 | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation<br>Capacitance | 70  | pF    | V <sub>CC</sub> = 5.0V |